

Morphometric study of *Euchiton traversii* complex (Gnaphalieae: Asteraceae)

Christina Flann^{A,B,E,F}, Ilse Breitwieser^C, Josephine M. Ward^D,
Neville G. Walsh^B and Pauline Y. Ladiges^A

^ASchool of Botany, The University of Melbourne, Vic. 3010, Australia.

^BNational Herbarium of Victoria, Royal Botanic Gardens Melbourne, Birdwood Avenue, South Yarra, Vic. 3141, Australia.

^CAllan Herbarium, Landcare Research, Lincoln 8152, New Zealand.

^DSchool of Biological Sciences, University of Canterbury, Christchurch, New Zealand.

^EPresent address: Nationaal Herbarium Nederland, Wageningen Branch, 6703 BL, Wageningen, The Netherlands.

^FCorresponding author. Email: christinaflann@gmail.com

Abstract. A morphometric study was undertaken into alpine and subalpine species of *Euchiton* Cass. (Gnaphalieae: Asteraceae) in the *Euchiton traversii* species complex in south-eastern Australia and New Zealand. Phenetic analysis of both field-collected and herbarium specimens resolved the following six taxa included: *Euchiton traversii* (Hook.f.) Holub, *Euchiton argentifolius* (N.A.Wakef.) Anderb., *Euchiton lateralis* (C.J.Webb) Breitw. & J.M.Ward, *Argyrotegium mackayi* (Buchanan) J.M.Ward & Breitw., *Argyrotegium fordianum* (M.Gray) J.M.Ward & Breitw. and *Argyrotegium poliochlorum* (N.G.Walsh) J.M.Ward & Breitw. The results support the segregation of the genus *Argyrotegium* J.M.Ward & Breitw. from *Euchiton*. *E. argentifolius* is distinct from *E. traversii*, but conspecific with *A. mackayi*. *E. lateralis* is present in Tasmania as well as New Zealand. The distribution of Australian *E. traversii* is redefined to mainland alpine regions with a few rare occurrences in Tasmania. Australian *E. traversii* was shown to be similar to its New Zealand counterparts. Differences between *E. lateralis* and *E. traversii* were clarified. *A. fordianum* and *A. poliochlorum* are distinct species and their transfer to *Argyrotegium* is supported.

Introduction

Delimitation of several species of *Euchiton* is difficult. Several taxonomic treatments have made progress, notably Drury (1972) and P. G. Wilson (unpubl. data); however, the *E. traversii* complex of alpine taxa in Australia and New Zealand is unresolved. Six species are included in this complex, spanning a generic split (Ward *et al.* 2003). They are all small herbs with attractive silver foliage, often forming mats or clumps.

In New Zealand, the following three species from this complex are recognised in the *Flora of New Zealand* (Webb 1988a): *E. traversii*, *E. lateralis* and *E. mackayi*; the last species has recently been transferred to the new genus *Argyrotegium* as *A. mackayi* (Ward *et al.* 2003). In Australia, the following four species from this complex are currently recognised: *E. traversii*, *E. argentifolius*, *E. poliochlorum* and *E. fordianum* (Everett 1992; Buchanan 1999; Walsh 1999a); the last two have been transferred to *Argyrotegium* as *A. poliochlorum* and *A. fordianum* (Ward *et al.* 2003). The superficial similarities between these taxa have made identification difficult.

The most problematic taxa are *E. argentifolius* and *E. traversii*, the core species of the complex. Material from both taxa has been referred to the '*E. traversii* complex' by Paul G. Wilson on herbarium determination slips. *Gnaphalium traversii* was published by J. D. Hooker (1867) on the basis of New Zealand material. This species is currently recorded as occurring in both

New Zealand and Australia (Fig. 1a; Curtis 1963; Webb 1988a; Hnatiuk 1990; Everett 1992; Kirkpatrick 1997; Walsh 1999a). It is a stoloniferous plant with silver leaves in basal rosettes and with solitary capitula.

Euchiton argentifolius, described as *Gnaphalium argentifolium* by Wakefield (1957), has been recorded only from Australia (Fig. 1b; Curtis 1963; Everett 1992; Walsh 1999a). It generally forms mats of silver foliage and has one to a few capitula. There is, at least superficially, a resemblance between this species and *E. traversii*. The generic position of *E. argentifolius* with regard to the new genus *Argyrotegium* also requires clarification (Ward *et al.* 2003).

In New Zealand (Fig. 1c), *E. lateralis*, initially described as *Gnaphalium laterale* C.J.Webb (Webb 1988b), is a small stoloniferous plant with a solitary capitulum reminiscent of *E. traversii*. The boundary between large *E. lateralis* and small *E. traversii* has caused difficulties in identification. Webb noted, both in the description (Webb 1988b) and in the *Flora of New Zealand* (Webb 1988a), that some Australian material referred to *G. traversii* (= *E. traversii*) would be better placed in *G. laterale* (= *E. lateralis*).

In Australia, two species have been described that were previously referred to *E. argentifolius*, namely *Argyrotegium fordianum* and *A. poliochlorum* (Fig. 1d, f). *A. fordianum* is the most robust of the species in this complex, with 5–15 capitula

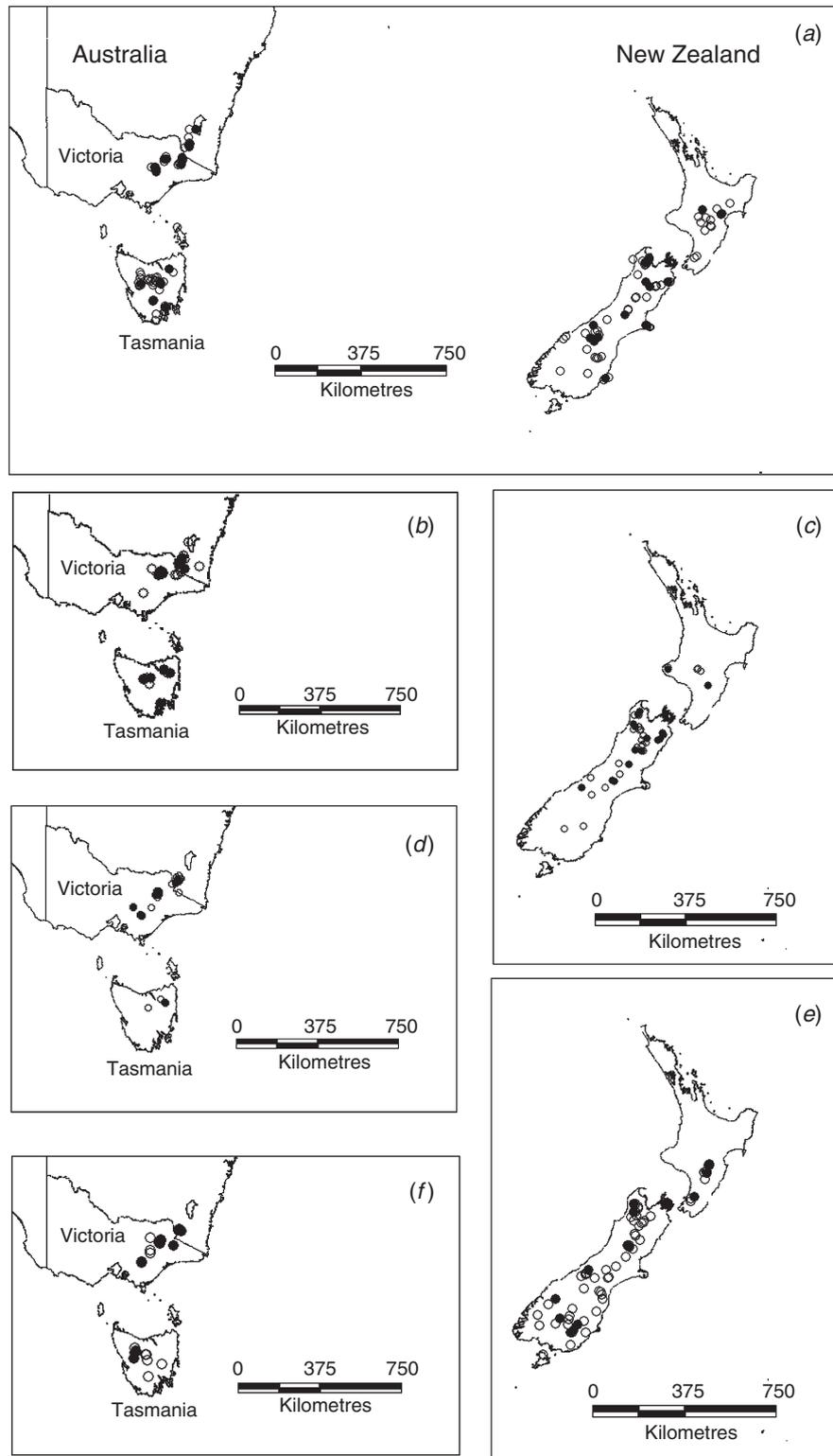


Fig. 1. Distribution of species and specimens scored for morphometric analysis. (a) *Euchiton traversii*; (b) *E. argentifolius*; (c) *E. lateralis*; (d) *Argyrotegium fordianum*; (e) *A. mackayi*; (f) *A. poliochlorum*. The range of the species is shown as open circles and the specimens included in this study as solid circles. Base distribution data was compiled from AD, AK, CANB, CHR, HO, MEL, NSW and electronic herbarium databases. Herbarium abbreviations follow Holmgren *et al.* (1990).

per inflorescence. Even though as a species it appears to be well delineated, is included in the present study on the basis of its previous inclusion under *E. argentifolius*. *A. poliochlorum*, the most recently described member of the complex (Walsh 1999b), differs from *E. argentifolius* in having larger capitula and from *A. fordianum* in having fewer (3–5), narrower capitula. It differs from both in having foliage that is grey-green rather than silvery-white as well as characters of the capitula.

Argyrotegium mackayi, recorded in the *Flora of New Zealand* (Webb 1988a) as a New Zealand endemic (Fig. 1e), was included because of its resemblance to *E. argentifolius*, being a small silvery-leaved herb with a solitary capitulum. Interestingly, *A. mackayi* has a historical connection to *E. traversii*. Initially, Buchanan (1882) described it as *Raoulia m'kayi*, although he noted that the large leaves allied it more closely to *Gnaphalium*. It was transferred to *G. traversii* as var. *mackayi* (Kirk 1899) where it remained until it was given specific status in *Gnaphalium* (Cockayne 1958). Webb (1988b), in the description of *G. laterale* (= *E. lateralis*), noted that specimens transferred to the new taxon were usually previously determined as *G. mackayi* (= *A. mackayi*) and he listed several characters for discriminating them. *A. mackayi* has terminal rather than lateral flowering stems and has glabrous cypselae as opposed to *E. lateralis*, which has cypselae hairs present.

Euchiton generally has the twin hairs characteristic of Gnaphalieae cypselae (Drury 1971; Anderberg 1991; Ward *et al.* 2003). The presence of paired papillae on the epidermal surface of the cypselae is restricted to *Euchiton* and it is one of the defining characters of the genus, clearly separating it from *Argyrotegium*, which has predominantly glabrous cypselae (Drury 1970, 1971, 1972; Anderberg 1991; Walsh 1999a; Ward *et al.* 2003; P. G. Wilson, unpubl. data). Previous work has illustrated cypselae of *E. traversii* (Drury 1970; Webb and Simpson 2001; Rozefelds 2001), *A. mackayi* (Webb and Simpson 2001) and *A. poliochlorum* (Rozefelds 2001), but not the other

species of the *E. traversii* complex. Investigation of the cypselae surface of *E. argentifolius* should allow insight into the generic placement of the species.

This is the first study of the *E. traversii* complex across both Australia and New Zealand. Species delimitation of this complex across a broad geographic range is investigated by morphometric analysis, and light and scanning electron microscopy of micro-anatomical features of cypselae.

Materials and methods

Sampling

Field trips to the states of Victoria, New South Wales and Tasmania in Australia and to New Zealand were undertaken during the spring and summer of 2001–2002. Where possible, flowering material was collected for herbarium specimens, consisting of 10 rosettes for stoloniferous species, or branches for the non-stoloniferous species. Material was collected and fixed in 70% ethanol also for examination by light microscopy. More than 100 collections were made across the two countries. The collections are lodged at MEL, with duplicates at CHR. Herbarium abbreviations follow Holmgren *et al.* (1990).

Herbarium specimens for the species in the *E. traversii* complex were obtained on loan to MEL from six herbaria (AD, CANB, CANU, CHR, HO, NSW). In all, 159 specimens from this herbarium material and field collections were chosen to cover the geographic range and morphological variation of the six species in the *E. traversii* complex (Table 1, Fig. 1). The number of specimens included per species was 45 for *E. argentifolius*, 23 for Australian *E. traversii*, 22 for New Zealand *E. traversii*, 19 for *E. lateralis*, 17 for *A. mackayi*, 16 for *A. fordianum* and 17 for *A. poliochlorum*.

Scanning electron microscopy was based on at least one specimen of each species, with duplicates for geographic regions; the inclusion of one cypselae per specimen included in the study was not possible owing to the destructive nature of the

Table 1. Herbarium specimens included in morphometric analysis

<i>Argyrotegium fordianum</i> :	AD96105053, AD96435032, CANB261591, CANB504945, CBG8001437, HO52361, MEL1579593, MEL2012171, MEL2017913, MEL599498, MEL2230361, MEL2230362, NSW474664, NSW474667, NSW474673, NSW474674
<i>Argyrotegium mackayi</i> :	CANB310251, CHR142889, CHR219262, CHR244057, CHR254066, CHR257168, CHR310131, CHR310239, CHR334912, CHR354304, CHR364334, CHR386935, CHR417870, CHR511432, CHR520084, CHR529011, MEL2230346
<i>Argyrotegium poliochlorum</i> :	CANB503129, CANB504061, CANB504843, CANB504927, CANB504946, CBG010828, HO409040, HO52377, HO92418, MEL1579970, MEL1579996, MEL584347, MEL611048, MEL2230365, MEL2230366, NSW425640, NSW461591
<i>Euchiton argentifolius</i> :	AD95745034, CANB174732, CANB252287, CANB271987, CANB344252, CANB344255, CANB344257, CANB344258, CANB366626, CANB366628, CANB366630, CANB366632, CANB505925, CANB93743, CBG9704588, CBG9705486, HO11318, HO142558, HO52362, HO69004, HO70751, HO70752, HO70830, HO91657, HO92568, MEL115633, MEL2020597, MEL2054178, MEL2061066, MEL593751, MEL612696, MEL627496, MEL695131, MEL719915, MEL2230342, MEL2230343, MEL2230344, MEL2230345, MEL2230360, NSW18767, NSW460779, NSW460780, NSW460781, NSW460783, NSW460794
<i>Euchiton lateralis</i> :	CHR116554, CHR131267, CHR215901, CHR223880, CHR228660, CHR269426, CHR311684, CHR354862, CHR363897, CHR366089, CHR382376, CHR394136, CHR395947, CHR401198, CHR402105, CHR420438, CHR469282, MEL2230363, MEL2230364
<i>Euchiton traversii</i> :	CANB504846, CANB7703786, CANU29858, CANU36412a, CANU36412b, CBG8001065, CBG8802311, CHR10142, CHR108547, CHR110579, CHR131266, CHR165900, CHR171945, CHR179245, CHR209747, CHR214865, CHR216781, CHR2505, CHR269420, CHR270028, CHR279200, CHR333624, CHR395921, CHR499789, HO143694, HO40558, HO52349, HO70870, MEL1504238, MEL1504239, MEL1581414, MEL2017344, MEL2061118, MEL49320, MEL674981, MEL2230347, MEL2230348, MEL2230350, MEL2230351, MEL2230367, NSW474752, NSW474753, NSW474754, NSW474760, NSW474762

sampling. Cypselae were chosen from dried herbarium material included in the morphometric analysis. Air-dried cypselae were mounted on stubs with double-sided carbon tape. Prepared specimens were sputter-coated with gold and examined with a JEOL 840 scanning electron microscope.

Morphometric measurements

In all, 64 characters were measured for this analysis (Table 2, dataset available as an Accessory Publication on the web). Of the characters measured, 13 were binary, 35 continuous quantitative, eight multi-state and eight counts. The dataset incorporated both characters that were expected to differ between species and those that are variable within as well as between species. It is important to compare specimens at similar stages of development; hence, fruiting specimens were preferentially chosen for measurements. The peduncle elongates between flowering and fruiting; therefore, peduncle length at fruiting stage provides comparable measurements. Specimens with at least three flowering plants, preferably fruiting, were collected. For each herbarium sheet, three ramets

were chosen as replicates to cover the variation and scored for all quantitative characters. Only one capitulum from each sheet was dissected because of the destructive nature of this sampling. Bracts and florets were separated individually for measurement.

Analysis

After averaging replicates, morphometric data were analysed phenetically with the PATN computer package (Belbin 1987). Analysis was undertaken of the whole complex as well as subsets. The Gower metric was used to create a dissimilarity matrix (Gower 1971), with the default setting in PATN. This metric was chosen because it has been shown to be the best association measure for mixed datasets and it also includes 0–0 matches (Crisp and Weston 1993; Ward 1993). Individuals were clustered into groups by hierarchical agglomerative clustering, based on the space-conserving unweighted pair-group method of arithmetic averages (UPGMA). Kruskal–Wallis values were calculated by PATN for groups defined in the dendrogram. The same association matrix was also used in an ordination analysis by hybrid multi-dimensional scaling (HMDS; Faith

Table 2. Characters used in morphometric analysis

<i>General</i>	<i>Inflorescence</i>
1. Stolons: 0 absent, 1 present	34. Type of inflorescence: 0 spreading, 1 solitary
2. Plant height (average, mm)	35. Inflorescence position: 0 terminal + axillary, 1 terminal, 2 lateral
3. Habit: 0 erect, 1 ascending, 2 mat-forming	36. Number of capitula per inflorescence
<i>Peduncle</i>	37. Diameter of inflorescence (average, mm)
4. Number of peduncles	38. Length of inflorescence (average, mm)
5. Peduncle diameter (average, mm)	<i>Capitula</i>
6. Length of internode between basal and cauline leaves (average, mm)	39. Diameter of capitulum (average, mm)
7. Length of internode between upper two cauline leaves (average, mm)	40. Length of capitulum (average, mm)
<i>Basal leaves</i>	41. Distance to widest point of capitulum from tip (average, mm)
8. Basal rosette: 0 absent, 1 present	42. Capitulum peduncle: 0 sessile, 1 pedunculate
9. Basal leaf shape: 0 linear, 1 oblanceolate, 2 obovate	<i>Outer bracts</i>
10. Basal leaf length (average, mm)	43. Number of bracts
11. Basal leaf width (average, mm)	44. Bract length (average, mm)
12. Distance to widest point of basal leaf from tip (average, mm)	45. Bract width (average, mm)
13. Abaxial basal leaf midvein: 0 not hairy, 1 hairy	46. Distance to widest point of bract from tip (average, mm)
14. Basal leaf adaxial indumentum: 0 absent, 1 moderate, 2 dense	47. Outermost bract indumentum: 0 sparse, 1 moderate, 2 dense
15. Basal leaf tip shape: 0 obtuse, 1 acute	<i>Inner bracts</i>
16. Length of narrowed base of basal leaf (average, mm)	48. Number of inner bracts
<i>Cauline leaves (uppermost)</i>	49. Inner bract length (average, mm)
17. Cauline leaf size (ascending): 0 uniform, 1 reduced	50. Inner bract width (average, mm)
18. Number of cauline leaves	51. Distance to widest point of inner bract from tip (average, mm)
19. Cauline leaf shape: 0 linear, 1 oblanceolate	<i>Bisexual florets</i>
20. Cauline leaf length (average, mm)	52. Number of bisexual florets per capitulum
21. Cauline leaf width (average, mm)	53. Bisexual floret length (average, mm)
22. Distance to widest point of cauline leaf from tip (average, mm)	54. Bisexual floret width apex (average, mm)
23. Cauline leaf colour: 0 discolorous, 1 concolorous	55. Bisexual floret width base (average, mm)
24. Cauline leaf adaxial indumentum: 0 sparse, 1 moderate, 2 dense	<i>Cypselae</i>
<i>Leaves subtending inflorescence (longest)</i>	56. Length of pappus bristles (average, mm)
25. Subtending leaves: 0 absent, 1 present	57. Cypselae length (average, mm)
26. Number of subtending leaves	58. Cypselae diameter (average, mm)
27. Subtending leaf shape: 0 linear, 1 lanceolate, 2 elliptic, 3 obovate	59. Hairs on cypselae: 0 absent, 1 present
28. Subtending leaf length (average, mm)	<i>Female florets</i>
29. Subtending leaf width (average, mm)	60. Number of female florets per capitulum
30. Distance to widest point of subtending leaf from tip (average, mm)	61. Female floret length (average, mm)
31. Subtending leaf colour: 0 discolorous, 1 concolorous	62. Female floret width apex (average, mm)
32. Subtending leaf adaxial indumentum: 0 absent, 1 sparse, 2 moderate, 3 dense	63. Female floret width base (average, mm)
33. Length of subtending leaf that exceeds the inflorescence (average, mm)	64. Pappus bristles: 0 falling singly or in groups, 1 connate

et al. 1987). The ordination was run 20 times from different random starting configurations and the result with the lowest stress value was used. Three-dimensional ordinations gave acceptable stress values, whereas two-dimensional plots had unacceptably high stress values of >0.2 (Faith *et al.* 1987).

Results

Figure 2 shows the dendrogram, with all 159 specimens coded by original identification and geographic location (see key). The dendrogram shows two main groups, A and B. Group A includes specimens of *E. argentifolius*, *A. mackayi*, *A. poliochlorum* and *A. fordianum*, and Group B those of *E. lateralis* and *E. traversii* (Table 3). Group A is further divided into four subgroups (1–4) and Group B into two subgroups (5, 6).

Group 1 consists of specimens originally referred to *A. mackayi* from New Zealand, mixed with specimens from both Tasmania and mainland Australia originally referred to *E. argentifolius*. Group 2 comprises only mainland Australian specimens of *E. argentifolius*. Group 3 consists predominantly of Australian specimens of *A. fordianum* from New South Wales, Victoria and Tasmania, along with two specimens of *A. poliochlorum* and two of *E. argentifolius*, all four from New South Wales. Group 4 is exclusively *A. poliochlorum*. Group 5 includes all of the New Zealand specimens of *E. lateralis* and all of the Tasmanian specimens of *E. traversii*. Group 6 consists of all of the specimens of *E. traversii* from both New Zealand and mainland Australia.

The ordination in three dimensions comparing the same specimens as in Fig. 2 provides a test of the cohesion of the groups shown in the dendrogram (Fig. 3). The six groups identified by the cluster analysis formed clusters in the ordination, with varying degrees of separation. No significant subclustering based solely on geographic groupings was apparent. To compare these results across a wider sample, the remaining specimens on loan were examined. The groups were confirmed across this wider range of specimens, except for Groups 1 and 2. These were not obviously morphologically distinct from each other, although together they were distinct from the other four groups.

Characters associated with the six groups that had high Kruskal–Wallis values are given in Table 4. Three characters that are particularly important for separating Groups A and B are the presence or absence of stolons and basal rosette as well as inflorescence position.

Argyrotegium fordianum (Group 3) and *A. poliochlorum* (Group 4) both formed tight clusters, with few other specimens included (Figs 2, 3). Given this result, combined with their ease of identification, no further analysis was performed on these species. The two groups that included specimens of *A. mackayi* and *E. argentifolius* (Groups 1 and 2) were analysed separately from the whole dataset as were the groups that included *E. lateralis* and *E. traversii* (Groups 5 and 6). This was done to check that the influence of the other groups had not obscured further patterns and to run comparative statistics (Kruskal–Wallis test).

Euchiton argentifolius–*A. mackayi*

All specimens of *A. mackayi* and *E. argentifolius* were included in the re-analysis of this subset. Two characters, stolons and basal

midvein, were removed as invariant. The same overall groups were obtained in the dendrogram (not shown) for this subset, although there was some rearrangement of individual specimens (see Table 5 for important characters). The ordination (Fig. 4) showed the specimens clustering loosely in Groups 1 and 2, but there was no clear disjunction between the groups.

Euchiton lateralis–*E. traversii*

All specimens of *E. lateralis* and *E. traversii* were included in the re-analysis of this subset, with two invariant characters, stolons and subtending leaf shape, removed. The re-analysed dendrogram (not shown) of *E. lateralis* and *E. traversii* showed the same groups with slight rearrangement of specimens, but within the same two clusters (Groups 5, 6, Fig. 2). The ordination (Fig. 5) showed clear groupings, with an obvious disjunction. The characters that were important in separating the groups are shown in Table 6.

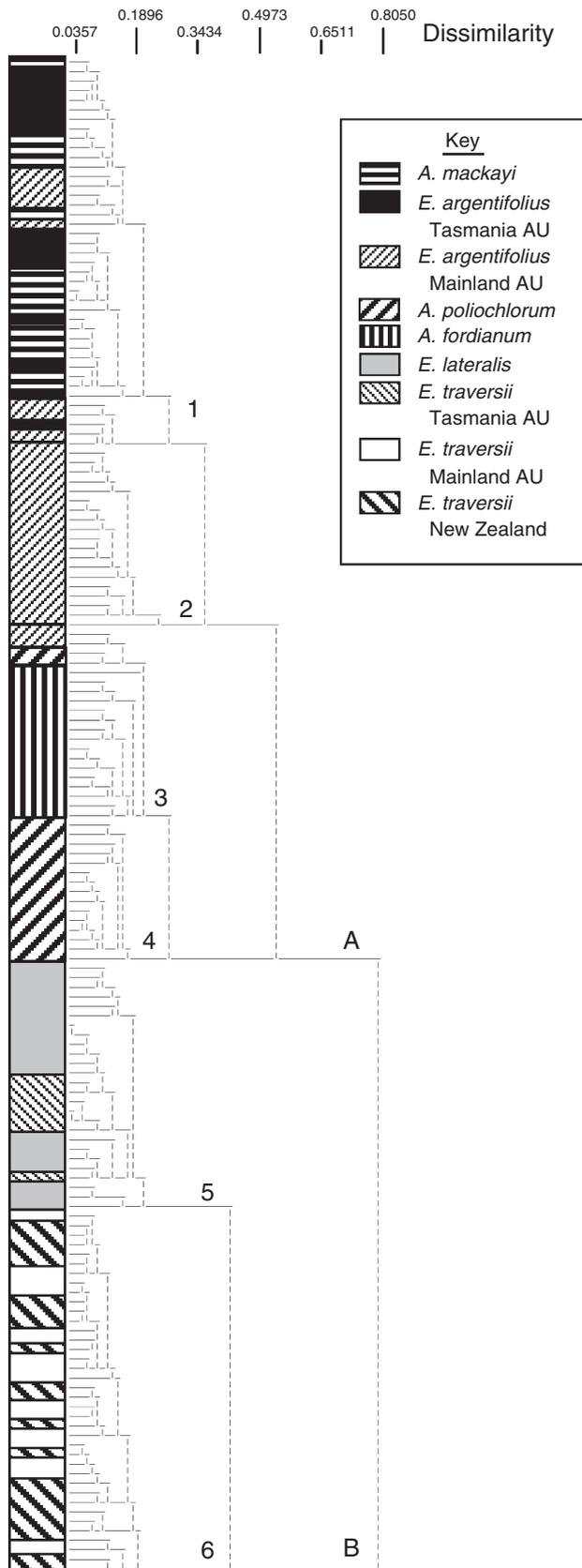
Scanning electron microscopy

Figures 6–8 illustrate cypselae ornamentation (hairs and papillae) in the six taxa included in the analysis of *E. traversii* complex. *E. argentifolius* (Tasmanian specimen, Fig. 6a–c) and *A. mackayi* (New Zealand specimen, Fig. 6m–o) usually lacked hairs on the cypselae (Fig. 6b, n); however, a specimen of *A. mackayi* from New Zealand (Fig. 6d–f), and two of *E. argentifolius* from Victoria (Fig. 6g–l), showed very few clavate twin hairs (Fig. 6e, k) or sparse clavate twin hairs (Fig. 6h). Neither Group 1 nor 2 shown in the dendrogram (Fig. 2) was internally consistent regarding the presence of hairs. A higher percentage (68%) of specimens lacked hairs on the cypselae in Group 1 than had them (20%, 12% missing data; Character 59, Table 2). Group 1 included all of the *A. mackayi* from New Zealand and *E. argentifolius* from Tasmania plus a few from the mainland. A slightly higher percentage (47%) had cypselae hairs than did not (42%, 11% missing data; Character 59, Table 2) in Group 2. Presence or absence of cypselae hairs did not allow discrimination of two clear groups, one corresponding to *A. mackayi* and one to *E. argentifolius*, regardless of geographic distribution.

Argyrotegium mackayi clearly displayed imbricate single papillae (e.g. Fig. 6o). Four specimens of *A. mackayi* and *E. argentifolius* had some semblance of a second papilla, although generally very small (Fig. 6c, f, i, l). *E. argentifolius* material from Tasmania showed almost featureless cells, with one flat papilla not extending much over the next cell, with the hint of a second papilla on some cells (Fig. 6c). The *A. mackayi* specimen with a few clavate hairs present also had tiny projections at the end of each cell opposite the large imbricate papilla (Fig. 6l). The Victorian specimens of *E. argentifolius* differed again in having one large papilla and one very small one, but the large papilla extended at right angles from the cell surface (Fig. 6f, i). However, none of the papillae in these images was more similar to the true paired papillae than to the single imbricate papilla state.

The cypselae of *A. fordianum* (Fig. 7a–c) lacked hairs but had minute imbricate papillae (Fig. 7c). In *A. poliochlorum* (Fig. 7d–f), the papillae were difficult to discern and appeared not, or barely, to overlap the adjoining cell (Fig. 7f).

The cypselae of both *E. lateralis* and *E. traversii* (Fig. 8a–l) had clavate twin hairs (Fig. 8b, e, h, k). These specimens all had



the paired papillae of true *Euchiton* (Fig. 8c, f, i, l). Although the specimen of *E. lateralis* from New Zealand (Fig. 8c) appeared almost smooth at high magnification, some paired papillae were apparent at lower magnification (Fig. 8b). During examination of cypselae it became apparent that some parts of their surface retained clearer evidence of these papillae than others.

Discussion

Overall pattern

Clear patterns emerged in this investigation, allowing for a reassessment of the delimitation of the *Euchiton traversii* complex at both the specific and generic level. The clusters shown in the analyses did not correspond directly to the six species as currently defined (Subgroups 1–6, Figs 2, 3), but instead shed light on the confusion in this species complex and offer hypotheses for its resolution.

The two main groups, A and B, correspond on the one hand to species included in the genus *Argyrotegium* (Ward *et al.* 2003) plus *E. argentifolius* (Group A) and on the other hand to species remaining in *Euchiton* (Group B).

Characters important in separating Groups A and B in the present analysis were stolons, basal rosettes and inflorescence position (Table 4). The presence of stolons and rosettes also distinguishes *Euchiton* from *Argyrotegium* (Ward *et al.* 2003); however, inflorescence position varies within *Euchiton* (Drury 1972; Webb 1988a). *A. nitidulum* is the only species referred to *Argyrotegium* not included in the present analysis, since we do not consider it to be part of the *E. traversii* complex.

The usual presence of epidermal hairs on the cypselae of *Euchiton* and their absence in *Argyrotegium* was considered by Ward *et al.* (2003) to be an important distinguishing character, although *A. mackayi* sometimes has a few hairs and the present study showed that these hairs are sometimes also present, although sparse, in *E. argentifolius* (Fig. 6).

According to the literature there are two types of cypselae epidermal papillae relevant to these taxa; these are paired papillae, unique to *Euchiton*, and single imbricate papillae in *Argyrotegium* (Drury 1970, 1971, 1972; Anderberg 1991; Breitwieser and Ward 2003; Ward *et al.* 2003). The present study showed some evidence for the presence of a second, much-reduced papilla in two species with imbricate papillae (*A. mackayi* and *E. argentifolius*, Fig. 6), thus providing a link between two character states previously recorded as distinct.

Argyrotegium fordianum–*A. poliochlorum*

Specimens of *A. fordianum* and *A. poliochlorum* formed well defined groups. Specimens of *A. poliochlorum* (Group 4, Fig. 2, Table 3) formed the only cluster that does not include specimens originally identified as other species. Group 3 (Fig. 2, Table 3) contained predominantly specimens of *A. fordianum* along with two specimens of *A. poliochlorum* and two of *E. argentifolius*. In reviewing these four specimens, it was apparent that they should not be referred to *A. fordianum*, and

Fig. 2. Dendrogram of the whole *Euchiton traversii* complex. Dendrogram of 159 specimens by 64 characters, run with the Gower metric and UPGMA. Letters A and B and Numbers 1–6 specify the groups discussed in the text and tables. AU = Australia.

Table 3. Number of specimens of each species in six groups based on original determinations

M = *A. mackayi*, A = *E. argentifolius*, F = *A. fordianum*, P = *A. poliochlorum*, L = *E. lateralis*, T = *E. traversii*. The numbers in column one correspond to the six groups in the dendrogram of Fig. 2

Group	No. of specimens						New Zealand			
	M	A	F	P	L	T	Tasmania	Victoria	New South Wales	
Group A1	17	24	–	–	–	–	17	15	3	6
Group A2	–	19	–	–	–	–	–	–	6	13
Group A3	–	2	16	2	–	–	–	2	8	10
Group A4	–	–	–	15	–	–	–	3	8	4
Group B5	–	–	–	–	19	7	19	7	–	–
Group B6	–	–	–	–	–	38	22	–	7	9

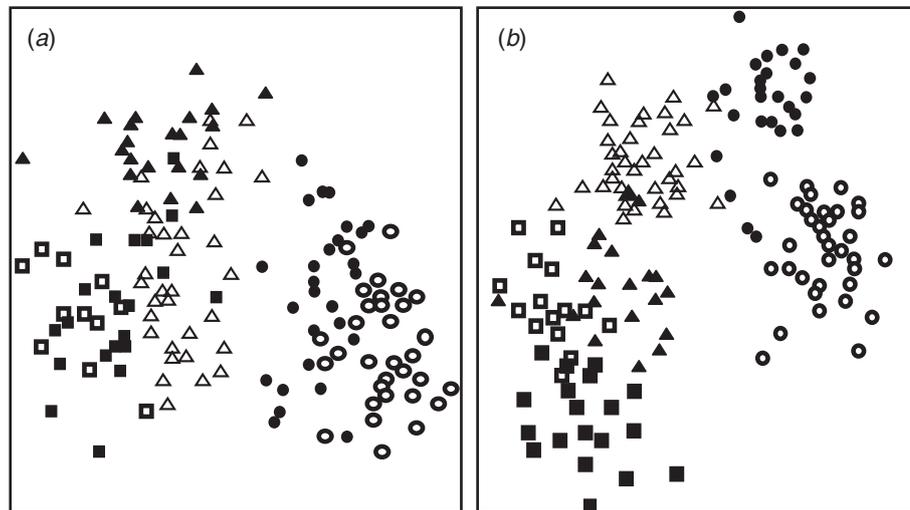


Fig. 3. Ordination of *Euchtiton traversii* complex. Ordination of 159 specimens of the *Euchtiton traversii* complex using 64 characters, run with the Gower metric and UPGMA. Stress: 0.1313. (a) Dimension 1 × 2; (b) dimension 1 × 3. Group 1: *Argyrotegium mackayi* and *E. argentifolius* (△). Group 2: *E. argentifolius* (▲). Group 3: *A. fordianum* (■). Group 4: *A. poliochlorum* (□). Group 5: *E. lateralis* and Tasmanian *E. traversii* (●). Group 6: *E. traversii* (○).

Table 4. Important characters separating the six groups in Fig. 2

For each, $P < 0.00001$, Kruskal–Wallis

Character	Group A1	Group A2	Group A3	Group A4	Group B5	Group B6
Stolons	Absent	Absent	Absent	Absent	Present	Present
Basal rosette	Mostly absent	Mostly absent	Mostly absent	Mostly absent	Mostly present	Mostly present
Inflorescence type	All or mostly singular	All or mostly racemose	All or mostly racemose	All or mostly racemose	All or mostly singular	All or mostly singular
No. of capitula	All or mostly one	Two to five	Five to ten	Two to five	All or mostly one	All or mostly one
Inflorescence position	Mostly terminal	Mostly terminal	Mostly terminal	Mostly terminal	Mostly lateral	Mostly lateral
No. of female florets	Generally < 70	Approx. 50–120	Generally < 70	Generally < 70	Generally < 70	Generally > 140

that the original identifications were correct. They cluster with the *A. fordianum* group because they are unusually large-leaved plants. Floral characters showed them to be correctly determined.

The scanning electron microscopic images of the cypselae of *A. fordianum* and *A. poliochlorum* (Fig. 7) confirmed an absence of twin hairs and paired papillae. There is no dissent within the literature regarding the presence of imbricate papillae on *A. fordianum* and *A. poliochlorum* cypselae (Walsh 1999b; Ward *et al.* 2003; P. G. Wilson, unpubl. data). Previous

images of *A. poliochlorum* have shown minute imbricate papillae (Rozefelds 2001); however, the specimen illustrated here had very reduced papillae, single if discernable, but hardly imbricate, indicating that this character is also more variable than originally thought. *A. fordianum* was shown to have epidermal papillae clearly of the imbricate type (Fig. 7) as recorded in Ward *et al.* (2003). The transfer of these species to the genus *Argyrotegium* (Ward *et al.* 2003) was supported by this additional evidence.

Table 5. Important characters separating *Argyrotegium mackayi* and *Euchiton argentifolius* groups in separate analysis of those taxa
For each, $P < 0.00001$, Kruskal–Wallis; groups refer to Fig. 2

Character	Group 1	Group 2	Notes
Inflorescence type	Mostly singular	All racemose	
No. of capitula	Mostly 1 (up to 2)	Mostly 3 (2–4)	
Cauline leaf length	<7 mm	>8 mm	Disjunct except outliers
Cauline leaf distance to widest point from tip	<3 mm	>3 mm	Disjunct except outliers
Cauline leaf shape	Linear, lanceolate or elliptic	Elliptic or oblanceolate	Overlap
Basal leaf length	Approx. < 10 mm	Approx. > 8 mm	Some overlap
Cauline leaf width	<1.5 mm	>1.3 mm	Some overlap
Capitulum pedunculate	Mostly sessile	Mostly pedunculate	Some overlap
Length of inflorescence	Approx. < 10 mm	Approx. > 10 mm	Some overlap
No. of subtending leaves	Generally less than 2	Generally greater than 2	Except outliers
Subtending leaf length	Approx. < 4 mm	Approx. > 4.5 mm	
No. of female florets	23–110	50–140	Large overlap

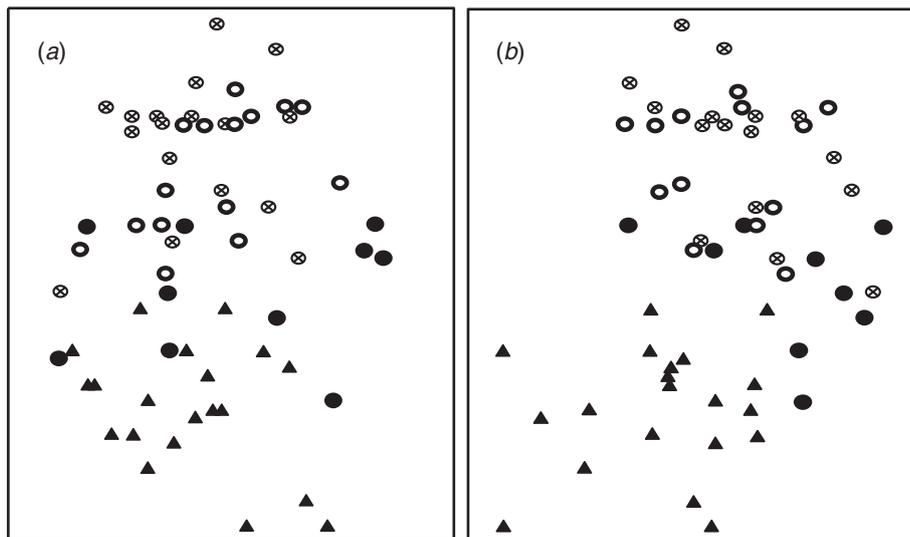


Fig. 4. Ordination of *Euchiton argentifolius* and *Argyrotegium mackayi*. Ordination of 62 specimens of *E. argentifolius* and *A. mackayi* using 62 characters, run with the Gower metric and UPGMA. Stress: 0.1672. (a) Dimension 1 × 2; (b) dimension 1 × 3. Group 1 from Fig. 2: *A. mackayi* New Zealand (⊗), *E. argentifolius*, Tasmania, Australia (○), *E. argentifolius*, mainland Australia (●). Group 2 from Fig. 2: *E. argentifolius*, mainland Australia (▲).

Euchiton argentifolius–*A. mackayi*

Through the analysis of this broad range of specimens an unexpected association has arisen between *E. argentifolius*, an Australian entity, and *A. mackayi*, believed until recently to be a New Zealand endemic. In 1994, one of us (J. W.) noted a resemblance to *A. mackayi* of a specimen of Tasmanian *E. argentifolius* (HO 520058, dupl. of CANU 38112) and after further collecting in Tasmania, deemed *A. mackayi* to be present in Australia (Ward *et al.* 2003). The possibility that Australia shared some alpine species of the *E. traversii* complex with New Zealand was suggested by Short (1987) as well as Webb (1988a, 1988b). In the analysis presented here, Group 1 (Fig. 2) clustered all of the Tasmanian *E. argentifolius* specimens and some of the mainland Australian specimens with all specimens of

A. mackayi. Group 2 contained the remaining *E. argentifolius* specimens, all from mainland Australia.

Argyrotegium mackayi is unequivocally present in Australia and includes specimens previously referred to *E. argentifolius* (Group 1, Figs 2, 4, Table 3). The overall similarity observed in the field is reflected in the similarity shown by morphometric character analysis. *A. mackayi* is found in the same habitats in the two countries, i.e. predominantly in subalpine herbfields. The new question is whether *E. argentifolius* exists in its own right or simply encompasses larger forms of *A. mackayi*, with a tendency to a higher number of capitula but with no clear disjunct characters. Analysis of the subset of the data including only these taxa did not alter the pattern, there being no clear disjunction to warrant recognition of two species (Fig. 4).

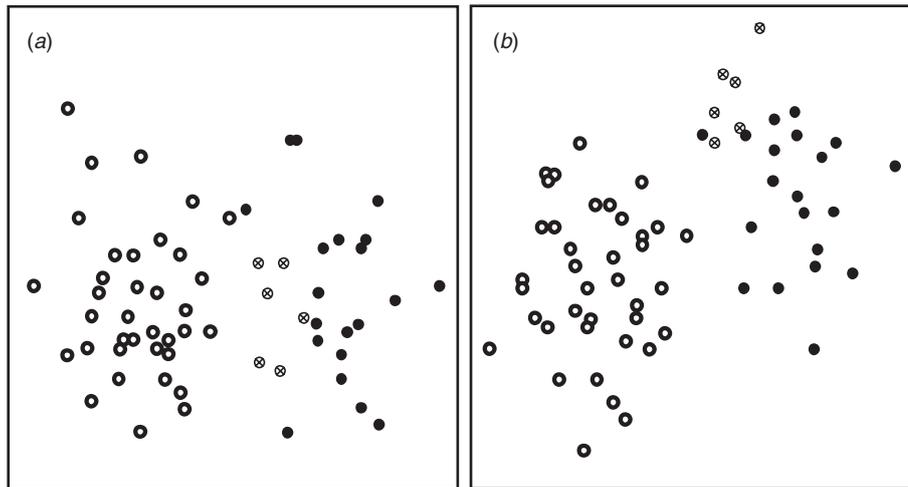


Fig. 5. Ordination of *Euchiton lateralis* and *E. traversii*. Ordination of 64 specimens of *E. lateralis* and *E. traversii* using 62 characters, run with the Gower metric and UPGMA. Stress: 0.1544. (a) Dimension 1 \times 2; (b) dimension 1 \times 3. Group 5 from Fig. 2: *E. lateralis* (●) and Tasmanian *E. traversii* (⊗). Group 6 from Fig. 2: mainland Australian *E. traversii* (○).

Table 6. Important characters separating *Euchiton lateralis* and *E. traversii* groups in separate analysis of those taxa

For all, $P < 0.00001$, Kruskal-Wallis; groups refer to Fig. 2

Character	Group 5	Group 6	Notes
No. of female florets	<80	>100	Disjunct
Inner bract length	Approx. < 5.3 mm	Approx. > 6 mm	Disjunct except outliers
Capitulum length	<6 mm	>7 mm	Disjunct
Length of inflorescence	<6 mm	>8 mm	Some overlap
No. of inner bracts	<18	Approx. > 20	Disjunct except outliers
No. of outer bracts	<7	>8	Disjunct except outliers
Female floret length	<3.7 mm	>4 mm	Disjunct except outliers
Length of pappus bristles	Approx. < 3.5 mm	>3.8 mm	Disjunct except outliers
Basal leaf width	Approx. < 4 mm	Approx. > 4.5 mm	Disjunct except outliers
Outer bract width	<1.5 mm	>1.6 mm	Disjunct except outliers
Bisexual floret length	Approx. < 3.7 mm	Approx. > 4 mm	Disjunct except outliers
Peduncle diameter	<1.25 mm	>1.25 mm	Disjunct except outliers

There are two character differences shown in Table 4 that are relevant to the comparison of Groups 1 and 2; the first is indicated by both the type of inflorescence and number of capitula, and the second by the number of female florets. The latter character showed overlap with generally fewer than 70 female florets in Group 1 and ~50–120 in Group 2.

When these groups were re-analysed separately, these same two characters appeared as important (with number of female florets less so); however, all showed overlap and the two groups consisted of a continuum with a seemingly arbitrary break (Table 5). Other characters that were important in the subset analysis are cauline, basal and subtending leaf-size characters, whether the capitula are pedunculate, length of inflorescence and number of subtending leaves (Table 5). In all cases, Group 1 had the lower number of counts and the smaller measurements and specimens in Group 2 seemed to be generally larger and have more capitula. None of these characters showed a clear disjunction as there was some overlap and the measurements could easily be interpreted as being part of a continuum across the two groups (Table 5).

A comparison of field-collected plants with plants grown in controlled conditions from seed of the same population showed that capitulum number varied phenotypically (data not included). Deletion of the characters inflorescence type and number of capitula, however, did not alter group composition, although groups were slightly less well defined. In all three analyses, including the whole *E. traversii* complex and the *E. argentifolius*–*A. mackayi* subset, both with and without the two influential inflorescence characters, two groups were shown but they were not discontinuous, and no characters clearly separated them.

In terms of geographic patterns within *E. argentifolius*, Group 1 includes all of the Tasmanian specimens plus some from mainland Australia, whereas all of the specimens in Group 2 are from mainland Australia. There is significant variation in plant size among members of Group 2 and, although the number of capitula is generally greater than in Group 1, there is no clear division to recognise *E. argentifolius* as a taxon separate from *A. mackayi*. All specimens on loan for these taxa were examined to check that those included in the analysis were not a biased

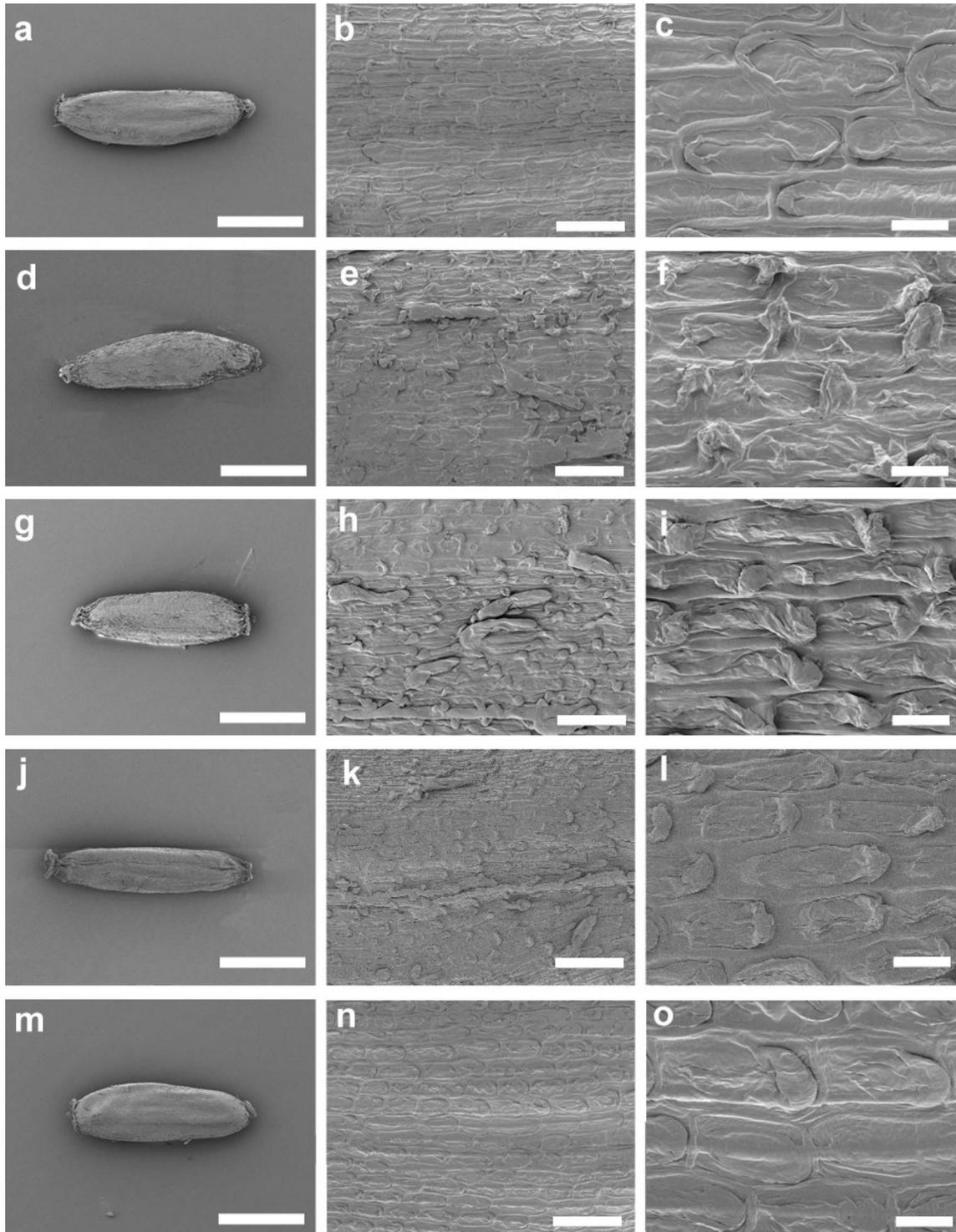


Fig. 6. Cypselas ornamentation for *Euchiton argentifolius* and *Argyrotegium mackayi*. (a–c) *E. argentifolius* (Tasmania, MEL2230360); (d–f) *E. argentifolius* (Victoria, MEL2230359); (g–i) *E. argentifolius* (Victoria, MEL 2020597); (j–l) *A. mackayi* (CHR 244047); (m–o) *A. mackayi* (MEL2230346). Scale bars = 500 μm (a, d, g, j, m), 50 μm (b, e, h, k, n) and 10 μm (c, f, i, l, o).

sample. The existence of larger, multiheaded specimens of *A. mackayi* from New Zealand was confirmed across the larger sample but the existence of the two separate taxa was not apparent.

Scanning electron microscopic evidence also contributed towards elucidating the relationship between *A. mackayi* and *E. argentifolius*. Despite *Argyrotegium* species usually having

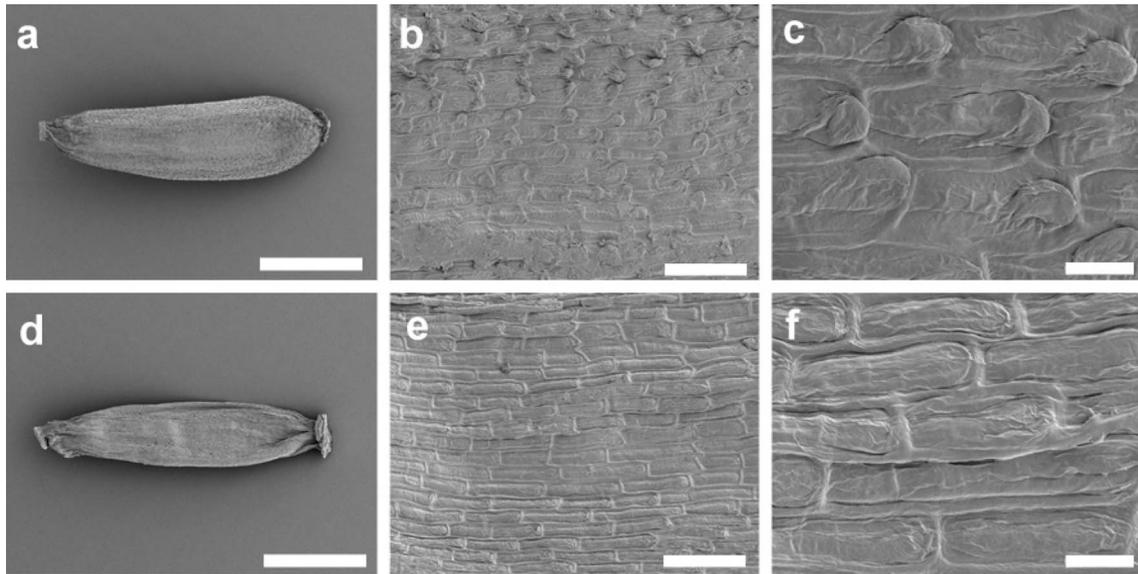


Fig. 7. Cypselae ornamentation for *Argyrotegium fordianum* and *A. poliochlorum*. (a–c) *A. fordianum* (MEL2230361); (d–f) *A. poliochlorum* (MEL2230366). Scale bars = 500 μm (a, d), 50 μm (b, e) and 10 μm (c, f).

glabrous cypselae, *A. mackayi* has been recorded as having few twin hairs present in some specimens (Webb and Simpson 2001; Breitwieser and Ward 2003; Ward *et al.* 2003). *E. argentifolius* was described as having glabrous cypselae, with a few specimens pubescent (Wakefield 1957). Since then, *E. argentifolius* has been recorded as having twin hairs present (Gray 1976; Everett 1992) or as glabrous or sparsely hairy (Walsh 1999a). One of the specimens of *E. argentifolius* shown here (Fig. 6b) was glabrous, the density of hairs on another (Fig. 6e) was very similar to that shown in Fig. 6k on a New Zealand *A. mackayi* specimen and the third (Fig. 6h) had a higher density of hairs although they were still sparse. Specimens studied here (Fig. 6) simply showed a gradation from glabrous to sparsely hairy, extending the variation slightly further than previously recorded. As the circumscription of *A. mackayi* has thus far encompassed the presence of a few hairs, the greater variation observed is able to be accommodated.

The cypselae in the three samples of *E. argentifolius* and the two of *A. mackayi* were not identical with regard to papillae (Fig. 6c, f, i, l, o). The specimens lacked the distinctive paired papillae of *Euchiton*; however, several had protrusions at the opposite end of the cell to the imbricate papilla. These were found on both *A. mackayi* and *E. argentifolius* specimens. In the same way that Webb and Simpson (2001) noted that cypselae of *E. mackayi* (= *A. mackayi*) often seem unornamented at lower magnifications because the papillae are so fine; perhaps these tiny secondary ‘vestigial’ papillae on these otherwise imbricate cypselae have been overlooked until now, owing to the unavailability of scanning electron microscopic images.

Variation is present in both *E. argentifolius* and *A. mackayi*, lending support to their recognition as the same species. Type material of *E. argentifolius* and *A. mackayi* was viewed at K and in collections from MEL and NSW. The material collected by Mueller from the Mungyang Mountains (Snowy Mountains) that was designated as lectotype of *Gnaphalium argentifolium* by Wakefield (1957) was slightly larger than the *A. mackayi*

material (as *Raoulia m'kayi* Buchanan 1882) but there were no conflicting characters between the type specimens. A comparison of the type descriptions of *E. argentifolius* (as *Gnaphalium argentifolium*, Wakefield 1957) and *A. mackayi* (as *Raoulia m'kayi*) showed few differences. In terms of habit, *A. mackayi* is described as prostrate (Buchanan 1882) whereas *E. argentifolius* is described as ascending (Wakefield 1957). Capitula are noted as solitary or a few together for *E. argentifolius* but capitulum number is not specified for *A. mackayi*, so inferred to be single.

On the basis of the phenetic analysis presented here, scanning electron microscopic evidence and examination of much herbarium material, including all of the relevant types, transfer of all *E. argentifolius* to *A. mackayi* is supported and this transfer will be effected in a future article summarising the taxonomy of the whole genus (C. Flann, unpubl. data). The close association between *A. mackayi* and *E. argentifolius* is not surprising, given the historical taxonomic confusion between *E. argentifolius*, *E. traversii* and *A. mackayi*. However, owing to the national nature of previous work, this overlap had not been observed. Examples such as this vindicate the importance of investigating taxa across their natural range and not according to political boundaries.

Euchiton lateralis–*E. traversii*

One of the other questions addressed by the present study was whether *E. lateralis* is present in Australia as well as New Zealand as suggested by Webb (1988a, 1988b) and Webb and Simpson (2001). The analyses of the whole *E. traversii* complex and the subset of only *E. lateralis* and *E. traversii* material clearly showed Tasmanian specimens identified as *E. traversii* clustering with *E. lateralis* (Group 5, Figs 2, 3, 5). These specimens also showed characters that delimit *E. lateralis*. As is discussed later, this does not indicate that the two are not well delimited, rather that most Tasmanian *E. traversii* material is better referred to *E. lateralis*. As the latter has not been recorded in Australia it was not an option

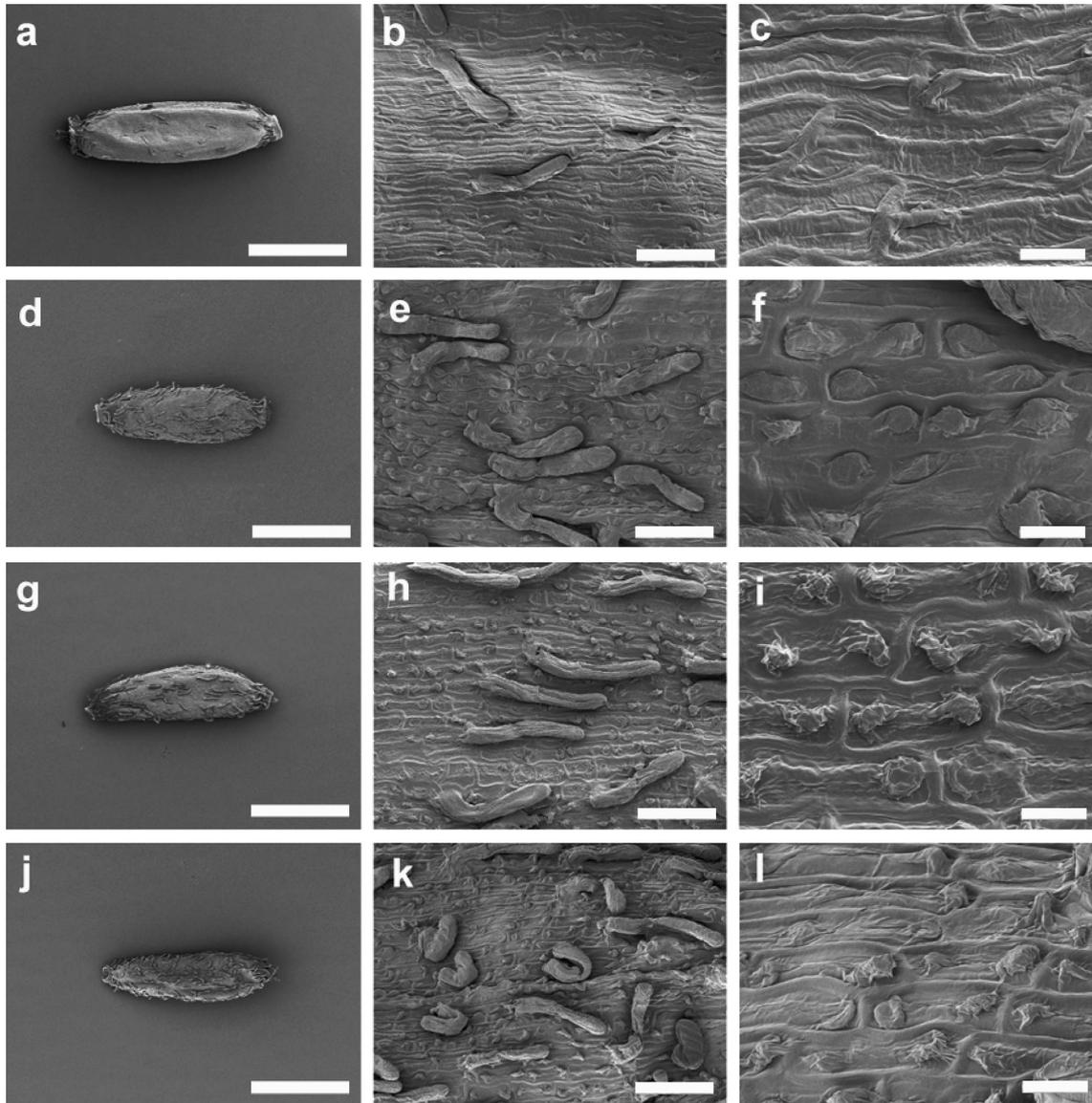


Fig. 8. Cypselae ornamentation for *Euchiton lateralis* and *E. traversii*. (a–c) *E. lateralis* (New Zealand, MEL2230363); (d–f) *E. lateralis* (Tasmania, HO70870); (g–i) *E. traversii* (Australia, MEL2230349); (j–l) *E. traversii* (New Zealand, MEL2230351). Scale bars = 500 μm (a, d, g, j), 50 μm (b, e, h, k) and 10 μm (c, f, i, l).

in available keys. All of the mainland Australia and New Zealand specimens of *E. traversii* clustered together in Group 6 and thus the species occurs on both land masses (Figs 2, 3, 5).

The most important character in distinguishing *E. lateralis* from *E. traversii* is the number of female florets, which shows a strong disjunction between the two groups. *E. lateralis* (Group 5) has generally fewer than 70 (up to 80) female florets per capitulum whereas *E. traversii* (Group 6) has generally more than 140 (from as few as 100, up to 280 in the present study). This upper value can be even higher; e.g. Drury (1972) noted *E. traversii* as having 233–305 female florets, possibly on the basis of glasshouse-grown material.

Overall, *E. lateralis* has smaller capitula, inner bracts, bisexual florets and pappus bristles, fewer inner and outer bracts and narrower basal leaf width. Most of these characters

showed a clear disjunction between taxa, with only a few outliers (Table 6).

Although the number of female florets is not enumerated in the type description of *E. lateralis*, being described as ‘many’, a difference in capitulum size from *E. traversii* was noted (Webb 1988b). The capitula of *E. lateralis* were recorded as 1.5–3.0 mm v. 4.0–6.0 mm in diameter in *E. traversii* and involucre bracts as 4.0–5.2 mm in *E. lateralis* v. 5.5–6.5 mm long in *E. traversii* (Webb 1988b). Capitulum diameter is a problematic character as it varies with stage of development and whether it is measured from pressed material, but the difference in length of bracts was confirmed by our data.

The cypselae of *Euchiton lateralis* and *E. traversii* have clavate twin hairs present in varying densities. The glabrous nature of some *E. lateralis* material recorded in Webb and

Simpson (2001) could be due to the frequent confusion between this species and *A. mackayi* in which the cypselae are indeed mostly glabrous. Allan (1961) included *G. traversii* var. *mackayi* (= *A. mackayi*) under *G. traversii* (= *E. traversii*), which explains why his description of the cypselae in *E. traversii* included a gradation from sparsely puberulous to glabrous.

There are no clear characters in cypselae ornamentation that separate *E. lateralis* and *E. traversii*, although there is a slight trend towards fewer hairs in *E. lateralis*.

The apparently clear geographic split between Tasmanian and mainland Australian material determined as *E. traversii* was unexpected. Although being a very clear split in our morphometric analysis, comparison with the rest of the relevant specimens on loan showed that most but not all Tasmanian material referred to *E. traversii* should be regarded as *E. lateralis*. Four specimens from Tasmania with high numbers of female florets, and so referable to *E. traversii* rather than *E. lateralis*, were seen in the loans examined; however, they were not included in this analysis. These were all from Cradle Mountain or the Great Lake region. In terms of distribution, this makes all of the alpine, silver, stoloniferous material with a solitary capitulum on the Australian mainland *E. traversii* and most in Tasmania *E. lateralis*. This means *E. traversii* is uncommon in Tasmania, a similar pattern of distribution and relative abundance to that of *A. poliochlorum* and *A. fordianum* which are both listed as rare in Tasmania (Department of Primary Industry, Water and Environment, Tasmania 2005; Department of Sustainability and Environment, Victoria 2005) but are relatively common in the alpine regions of mainland Australia (Everett 1992; Walsh 1999a).

Euchiton argentifolius–*E. traversii*

One of the original questions, ‘Are *E. argentifolius* and *E. traversii* the same species?’, was clearly answered by this analysis. They are not the same species and, in fact, specimens previously regarded as *E. argentifolius* form a continuum with *A. mackayi* when analysed morphometrically. This means that the question that ends up being asked is whether *A. mackayi* (including *E. argentifolius*) is different from *E. traversii* sens. str. (excluding those specimens now referred to *E. lateralis*). The answer to this question is clearly ‘Yes’. In line with the generic difference supported by the overall pattern of the analysis, these two species fall into different groups in all analyses and are separated by many characters. The same characters that are important in distinguishing *Argyrotegium* from *Euchiton* are therefore relevant to the comparison of these species. The most obvious difference between *A. mackayi* and *E. traversii* appears to be habit related. *E. traversii* has a definite rosette and stolons connecting plantlets, as opposed to a highly developed branching structure at or near ground level, but with no stolons, a habit which is exhibited by *A. mackayi* (and *A. poliochlorum* and *A. fordianum*). The inflorescence is terminal in *A. mackayi* but lateral in *E. traversii*. Cauline leaves generally appear much more reduced on *E. traversii* specimens, which also have a generally higher number of female florets.

Material lacking clear information regarding stolons could easily have contributed to the previous taxonomic confusion, as identification of stolons and habit can be affected by the quality

and presentation of the specimens. When redetermining the loans in the light of this analysis, several collections from Tasmania previously identified as *E. traversii* were transferred to *A. mackayi*.

On referring to the relevant literature it is apparent that much of this information has been known, but not synthesised into a comprehensible solution. Webb (1988a) noted that *A. mackayi* was treated as a variety of *E. traversii* at one point, and listed its mat-forming habit, terminal capitula and glabrous achenes as distinguishing characters. Walsh (1999a) also noted the distinctiveness of *E. argentifolius* and *E. traversii* in that the latter had larger, solitary capitula and larger, distinctly rosetted leaves. These are the same differences as those between *A. mackayi* and *E. traversii*. In the original description of *E. argentifolius*, Wakefield (1957) noted a superficial similarity between his new species and *E. traversii* but listed the definite rosettes of basal leaves, solitary, pedunculate flower heads and pubescent cypselae of *E. traversii* as proof of their difference. In conclusion, the differences between *E. argentifolius* and *E. traversii* found here are the same as those noted in the original description of *E. argentifolius*.

Scanning electron microscope evidence showed that the cypselae of *A. mackayi* are usually glabrous, with at most a sparse scattering of twin hairs (Fig. 6b, e, h, k, n), whereas the cypselae of *E. traversii* consistently have hairs present in a higher density (Fig. 8h, k). The presence of paired papillae on *E. traversii* (Fig. 8i, l), compared with the imbricate papillae of *A. mackayi*, is a character that clearly distinguishes the two species, even with a few reduced second papillae present on some material of *A. mackayi* (Fig. 6c, f, i, l, o).

Euchiton lateralis–*A. mackayi*

There is also an association between the specimens of *A. mackayi* and *E. lateralis*. These two species can easily be confused when examining herbarium specimens if material containing stolons is unavailable and capitulum attachment is unclear. It is interesting that they appear superficially similar but have been placed in different genera as *Argyrotegium mackayi* and *Euchiton lateralis*. Webb (1988a) separated these two taxa very early on in the key to *Gnaphalium* (including *Euchiton*), by using the characters ‘cypselae glabrous, flowering stems terminal and plants mat-forming’ to designate *G. mackayi* (= *A. mackayi*), and ‘cypselae hairy or sparsely papillate, flowering stems 1–3, lateral, plants growing singly or in loose patches’ for *G. laterale* (= *E. lateralis*). Because of the similarities between *E. lateralis* and *E. traversii*, these are the same characters that separate the latter from *A. mackayi*, as noted above. The scanning electron microscopy characters, as discussed above, also separate *A. mackayi* and *E. lateralis* in that the cypselae of the former are usually glabrous with imbricate papillae while the latter has twin hairs present and paired papillae (Figs 6, 8).

Conclusions

Historically, the species of the *E. traversii* complex have caused confusion in their circumscription and identification. *A. mackayi* was once treated as a subspecies of *E. traversii*. Some specimens referred to *A. mackayi* are now known to be *E. lateralis*. Similarities exist between *E. lateralis* and *E. traversii*. There has been confusion between *E. traversii* and *E. argentifolius*.

In summary, *E. argentifolius* is not the same species as *E. traversii*. It is, however, conspecific with *A. mackayi*. Inclusion of material identified as *E. argentifolius* in the circumscription of *A. mackayi* adds more evidence for variation in papillae already noted (Ward *et al.* 2003). The distribution of *A. mackayi* with this altered circumscription covers alpine regions of mainland Australia, Tasmania and New Zealand.

Euchiton lateralis is shown to be present in Tasmania as well as in New Zealand. Australian *E. traversii* material is confirmed as conspecific with its New Zealand counterpart and in Australia *E. traversii* is found in mainland alpine regions, with a few records from Cradle Mountain and the Great Lake region in Tasmania.

Segregation of the genus *Argyrotegium* from *Euchiton* was supported by the present study and the evidence, including scanning electron microscope imaging, confirmed the inclusion of *A. fordianum* and *A. poliochlorum* in *Argyrotegium*. These two species were confirmed to be distinct despite both previously being included in a more broadly circumscribed *E. argentifolius*.

Further issues regarding nomenclatural changes will be published in the future.

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